

U.S. DEPARTMENT OF COMMERCE PATENT & TRADEMARK OFFICE

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B/O Form PTO-1390		<b>Transmittal Letter to the United States Designated/Elected Office (DO/EO/US) Concerning a Filing Under 35 USC 371</b>	Attorney's Docket Number CHOI3001/REF/57
			U.S. Application Number (if known) <b>09/186357</b>
International Application Number PCT/KR99/00557	International Filing Date September 16, 1999	Priority Date Claimed September 17, 1998	
Title of Invention ELECTRONIC COMPONENT LEAD INSPECTION DEVICE			
Applicant(s) for DO/EO/US CHOI et al.			

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items under 35 USC 371:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 USC 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 USC 371.
3. ☒ This express request to begin national examination procedures (35 USC 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 USC 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed 35 USC 371(c)(2).
  - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
  - b. ☒ has been transmitted by the International Bureau.
  - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ A translation of the International Application into English (35 USC 371(c)(2)).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 USC 371(c)(3))
  - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
  - b. ☐ have been transmitted by the International Bureau.
  - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
  - d. ☒ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 USC 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 USC 371(c)(4)). ( ☒ Executed ☐ Unexecuted )
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 USC 371(c)(5)).

Items 11 to 16 below concern other document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☐ A **FIRST** preliminary amendment.  
☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☐ Other items or information:

Application Number (if Known) <b>09/786357</b>		International Application Number <b>PCT/KR99/00557</b>		Attorney's Docket Number <b>CHOI3001/REF/557</b>	
				Calculations	PTO USE ONLY
17. The following fees are submitted: <b>Basic National Fee (37 CFR 1.492(a)(1)-(5)):</b> <input type="checkbox"/> Search report has been prepared by the EPO or JPO ..... \$860.00 <input type="checkbox"/> International Preliminary Examination Fee paid to USPTO (37 CFR 1.482) ..... \$690.00 <input type="checkbox"/> No International Preliminary Examination Fee paid to USPTO (37 CFR 1.482) but International Search Fee paid to USPTO (37 CFR 1.445(a)(2)) ..... \$710.00 <input checked="" type="checkbox"/> Neither International Preliminary Examination Fee (37 CFR 1.482) nor International Search Fee (37 CFR 1.445(a)(2)) paid to USPTO ..... \$1000.00 <input type="checkbox"/> International Preliminary Examination Fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) ..... \$100.00				\$1,000.00	
<b>ENTER APPROPRIATE BASIC FEE AMOUNT</b>				<b>\$ 1,000.00</b>	
Surcharge of <b>\$130.00</b> for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).					
<b>CLAIMS</b>	<b>NUMBER FILED</b>	<b>NUMBER EXTRA</b>	<b>RATE</b>		
Total Claims	11 -20 =	0	× \$18.00	\$ 0.00	
Independent Claims	6 -3 =	3	× \$80.00	\$ 240.00	
Multiple Dependent Claims (if applicable)			+ \$270.00		
<b>TOTAL OF ABOVE CALCULATIONS</b>				<b>\$ 1,240.00</b>	
Reduction by ½ for filing by small entity, if applicable. Small Entity Status is asserted pursuant to 37 CFR 1.27 for this application.				\$ 620.00	
<b>SUBTOTAL</b>				<b>\$ 620.00</b>	
Processing fee of <b>\$130.00</b> for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).					
<b>TOTAL NATIONAL FEE</b>					
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). <b>\$40.00</b> per property.				\$ 40.00	
<b>TOTAL FEES ENCLOSED</b>				<b>\$ 660.00</b>	
				Amount to be:	Refunded:
					Charged:

- a. ☒ A check in the amount of \$660.00 to cover the fees is enclosed.
- b. ☐ Please charge my Deposit Account Number 02-0200 in the amount of \$ to cover the above fees. A duplicate copy of this sheet is enclosed.
- c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account Number 02-0200. A duplicate copy of this sheet is enclosed.

Note: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

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DATE: March 14, 2001

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ELECTRONIC COMPONENT LEAD INSPECTION DEVICE

BACKGROUND OF INVENTION

FIELD OF THE INVENTION

The present invention relates to an electronic component lead inspection  
5 device, and more particularly to an electronic component lead inspection device  
adapted to acquire an image of an electronic component lead and to inspect  
whether the electronic component leads are good or bad according to the  
acquired image.

DESCRIPTION OF THE PRIOR ART

10 Various types of electronic component lead inspection devices are  
disclosed. One of them is illustrated in Figure 1, where, an integrated circuit  
package 1 positioned on a pedestal (not shown) formed at a glass plate 2 is  
inspected by light from four light sources (3, 4, 5, 6) located at four corners,  
which sequentially illuminate the package 1 to check if electronic component  
15 leads are good or bad.

In other words, when one light source 3 illuminates light, images of the  
electronic component lead from two directions can be obtained, such that when  
four light sources (3, 4, 5, 6) sequentially illuminate light, images on position of  
electronic component leads in four directions can be obtained. Inspection  
20 procedures of electronic component lead by the electronic component lead  
inspection device thus described will be explained as below:

An electronic component package on a tray is put on a pickup header  
and moved to an inspection position, and the electronic component package is  
put on a pedestal and pressed. Light is sequentially illuminated on the electronic  
25 component package laid on the pedestal to obtain an image on a position of  
electronic component lead in four directions.

Then, a pickup header lifts the electronic component package and puts it on the tray to thereby finish an inspection procedure of electronic component lead against one electronic component package.

However, there is a problem in the electronic component lead inspection device thus described in that an electronic component package should always maintain a fixed state to get an accurate image information on electronic component leads while images of the electronic component lead in four directions are continuously acquired.

Furthermore, there is another problem in that so the pickup header moves the electronic component package horizontally and vertically, mechanical driving time is much consumed and the probability of electronic component lead being damaged is high while the pickup header is driven. There is still another problem in that an image should be sequentially input at least more than twice to thereby take stand still times in acquiring images. There is still further problem in that inspection items such as mold damage, mold thickness, mold angle, shoulder length, shoulder angle and the like cannot be inspected.

Meanwhile, in an electronic component lead inspection device according to another prior art, a prism and a reflecting mirror are used, as illustrated in Figures 2a, to enlarge twice the image of the electronic component lead and to divide the image into two for view in up-and-down positions, as illustrated in Figure 2b.

Inspection procedures of electronic component lead by the electronic component lead inspection device according to second prior art will be described as under:

An electronic component package on a tray is picked up by a pickup header, flipped by a mechanical method and is moved to inspection position. The flipped electronic component package is put on a pedestal while the pickup

header is moved from the inspection position to an original position. The electronic component package is rotated four times per direction of the electronic component lead to obtain images in four directions while the electronic component package is laid on the pedestal. Next, the electronic component package is picked up by the pickup header, flipped by a mechanical method and moved on a tray, by which, an inspection procedure of an electronic component lead against one electronic component package is finished.

However, there is a problem in the electronic component lead inspection device thus described in that the pedestal should accurately rotate the electronic component package according to each direction of the electronic component lead, and if the pedestal cannot rotate the electronic component package at an exact angle or there occurs any vibration, an accurate inspection of the electronic component lead cannot be performed.

Furthermore, there is another problem in that the pickup header moves the electronic component package horizontally and vertically and rotates same, a mechanical driving time is much consumed and the probability of the electronic component lead being damaged is high while the pickup header is driven. There is still another problem in that an image should be sequentially acquire at least more than twice to thereby take lots of times in acquiring images. There is still further problem in that inspection item such warpage, mold damage and the like cannot be performed.

Meanwhile, in an electronic component lead inspection device according to a third prior art, four cameras (11, 12, 13, 14) are used, as shown in Figure 3, to acquire each side view of an electronic component package 15 and to check whether an electronic component leads are good or bad. Inspection procedures of electronic component lead by the electronic component lead inspection device according to the third prior art will be described as follows:

An electronic component package on a tray is picked up by a pickup

header, moved to an inspection position and laid on a pedestal. Four cameras acquire each side of the electronic component package while the electronic component package is laid on the pedestal. Next, the electronic component package is lifted by the pickup header to thereafter be laid on the tray, by which  
5 the inspection procedure of the electronic component lead against one electronic component package is finished.

However, there is a problem in the third electronic component lead inspection device thus described in that a lead portion of the electronic component package gets in touch with the pedestal to thereby incur a damage to  
10 the electronic component lead.

Furthermore, there is another problem in that, because the pickup header moves the electronic component package vertically and horizontally, a mechanical driving time is much consumed and the probability of electronic component lead being damaged is high while the pickup header is driven.

15 There is still another problem in that inspection items such as warpage, foot angle, mold damage, mold thickness, mold angle, shoulder length, shoulder angle and like cannot be performed.

#### SUMMARY OF THE INVENTION

Conclusively, there are lots of problems in the electronic component lead  
20 inspection devices thus described according to the prior arts in that frequency of mechanical movement is increased in order to inspect the electronic component package on a particular inspection position, such that the electronic component packages being produced cannot be inspected on real time. There is another problem in that the probability of the electronic component leads being damage  
25 is high. There is still another problem in that there may be items that cannot be inspected.

Accordingly, the present invention is disclosed to solve the

aforementioned problems and it is an object of the present invention to provide an electronic component lead inspection device adapted to inspect electronic component package while they are moved so that the electronic component package being produced can be inspected on real time to thereby incur no damages to electronic component lead.

It is another object of the present invention to provide an electronic component lead inspection device adapted to accurately inspect inspection items impossible to be inspected in the prior arts and configured to be easily coupled for use to existing electronic component device according to miniaturization and shortened mechanical control time.

In accordance with the objects of the present invention according to a first embodiment thereof, there is provided an electronic component lead inspection device, the device comprising:

a pickup header for picking up an electronic component package to move same;

a light source for illuminating a light to the electronic component package;

acquiring means for acquiring an image of the electronic component package underneath a travelling passage of the electronic component package;

control means for outputting an image signal of the electronic component package acquired by the acquiring means; and

inspecting and displaying means for receiving the image signal of the electronic component package output from the control means to inspect and display the image of the electronic component package.

In accordance with the objects of the present invention according to a second embodiment thereof, there is provided an electronic component lead inspection device, the device comprising:

a pickup header for picking up an electronic component package to move

same;

a reflecting plate attached to the pickup header;

a light source for illuminating a light to the reflecting plate;

acquiring means for acquiring an image of the electronic component

5 package underneath a travelling passage of the electronic component package;

control means for outputting an image signal of the electronic component package acquired by the acquiring means; and

10 inspecting and displaying means for receiving the image signal of the electronic component package output from the control means to inspect and display the image of the electronic component package.

In accordance with the objects of the present invention according to a third embodiment thereof, there is provided an electronic component lead inspection device, the device comprising:

a pickup header for picking up an electronic component package to move

15 same;

a reflecting plate attached to the pickup header;

a first light source for illuminating a light to the reflecting plate;

a second light source for illuminating a light to the electronic component package;

20 acquiring means for acquiring an image of the electronic component package underneath a travelling passage of the electronic component package;

control means for controlling the first light source to illuminate a light if the electronic component package is a gull wing type electronic component package and for controlling the second light source to illuminate a light if the  
25 electronic component package is a ball grid array type electronic component package and for outputting an image signal of the electronic component package acquired by the acquiring means; and

inspecting and displaying means for receiving the image signal of the electronic component package output from the control means to inspect and



display the image of the electronic component package.

In accordance with the objects of the present invention according to a fourth embodiment thereof, there is provided an electronic component lead inspection device, the device comprising:

- 5 a tray for moving an accommodated electronic component;
- a light source for illuminating a light to the electronic component package;

acquiring means for acquiring an image of the electronic component package above a travelling passage of the electronic component package;

- 10 control means for outputting an image signal of the electronic component package acquired by the acquiring means; and

inspecting and displaying means for receiving the image signal of the electronic component package output from the control means to thereby inspect and display the image of the electronic component package.

#### 15 BRIEF DESCRIPTION OF THE DRAWINGS

For fuller understanding of the nature and objects of the invention, reference should be made to the following detailed description taken in conjunction with the accompanying drawings in which:

- Figure 1 is a schematic diagram of an electronic component lead inspection device according to the prior art;

Figures 2a and 2b are schematic views of electronic component lead in images acquired by another electronic component lead inspection device according to the prior art;

- Figure 3 is a schematic diagram of a still another electronic component lead inspection device according to the prior art;

Figure 4 is a schematic diagram of an electronic component lead

inspection device according to the first, second and third embodiments of the present invention;

Figure 5 is a control block diagram of an electronic component lead inspection device according to the first, second and third embodiments of the present invention;

Figure 6 is an enlarged view of principal parts of an electronic component lead inspection device according to the first, second and third embodiments of the present invention;

Figure 7 is an enlarged view of principal parts of an electronic component lead inspection device according to the fourth embodiment of the present invention;

Figure 8 is plan of a conventional gull wing type electronic component package;

Figure 9 is a drawing for illustrating passages where a bottom view image of an electronic component lead is transmitted in acquiring means according to the first embodiment of the present invention;

Figure 10 is a drawing for illustrating passages where images of a first side view and a third side view of an electronic component lead are transmitted in acquiring means according to the first embodiment of the present invention;

Figure 11 is a drawing for illustrating passages where images of a second side view and a fourth side view of an electronic component lead are transmitted in acquiring means according to the first embodiment of the present invention;

Figures 12a, 12b and 12c are drawings for illustrating passages where bottom view and side view images of an electronic component lead are transmitted in acquiring means according to the second embodiment of the

present invention;

Figure 13 is a drawing for illustrating a passage where a side view image of an electronic component lead is transmitted in acquiring means according to a third embodiment of the present invention;

5        Figure 14a, 14b and 14c are drawings for illustrating bottom view and side view images of a gull wing type electronic component package acquired by an electronic component lead inspection device according to the present invention; and

10        Figures 15a, 15b and 15c are drawings for illustrating bottom view and side view images of a ball grid array type electronic component package acquired by an electronic component lead inspection device according to the present invention.

#### DETAILED DESCRIPTION OF THE INVENTION

15        Now, preferred embodiment of the present invention will be described in detail with reference to the accompanying drawings.

20        Figure 4 is a schematic sectional view of an electronic component lead inspection device according to the first, second and third embodiments of the present invention and Figure 5 is a control block diagram of an electronic component lead inspection device according to the first, second and third embodiments of the present invention while Figure 6 is an enlarged view of principal parts of an electronic component lead inspection device according to the first, second and third embodiments of the present invention.

25        As illustrated in Figures 4, 5 and 6, an electronic component lead inspection device according to the first, second and third embodiments of the present invention includes a pickup header 105, a reflecting plate 110, a first light source 115, a second light source 120, acquiring means 200, position

detecting means 300, control means 400 and inspecting and displaying means 500.

The pickup header 105 serves to pick up an electronic component package 100 to horizontally move same, and the reflecting plate 110 attached to the pickup header 105 is painted at a bottom surface thereof with material such as irregular reflection paint for irregularly diffusing the light.

The first light source 115 illuminates a light to the reflecting plate 110 according to control of the control means 400 and the second light source 120 illuminates a light to the electronic component package 100 being horizontally moved by the pickup header 105 according to control of the control means 400, where, by way of example, the first and second light source 115 and 120 can be made by utilizing a light emitting diode (LED).

The acquiring means 200, disposed underneath a travelling passage of the electronic component package 100 being horizontally moved by a pickup header 105, serves to acquire an image of the electronic component package 100 to output same to the control means 400.

Furthermore, the acquiring means 200 is provided thereon with a transparent glass plate 205 for passing an image of the electronic component package 100 being horizontally moved by the pickup header 105 but for preventing foreign objects such as dust, mold flesh and the like from entering the acquiring means 200.

The position detecting means 300 detects a position of the electronic component package 100 to output to the control means 400 a signal that the electronic component package 100 has arrived at acquiring position. The position detecting means may be arranged at one side of an electronic component lead inspection device according to the present invention, or may be installed at an apparatus for driving the pickup header 105.

The control means 400 controls the first light source 115 to illuminate a light toward the reflecting plate 110 when a signal is input from the position detecting means 300 that the electronic component package 100 has reached the acquiring position in case the electronic component package 100 being horizontally moved by the pickup header 105 is a gull wing type electronic component package. The control means 400 controls the second light source 120 to illuminate a light toward the electronic component package when a signal is input from the position detecting means 300 that the electronic component package 100 has arrived at the acquiring position in case the electronic component package 100 being horizontally moved by the pickup header 105 is a ball grid array (BGA) type electronic component package.

Furthermore, the control means 400 receives an image signal of the electronic component package 100 acquired by the acquiring means 200 to output same to the inspecting and displaying means 500, where, the inspecting and displaying means receives the image signal of the electronic component package 100 output from the control means 400 to inspect and display the image of the electronic component package 100.

Although it is not illustrated in the drawings, it is preferable that an air blower is provided in order to eliminate dust, mold flesh and the like accumulated on the glass plate 205 mounted above the acquiring means 200.

Figure 7 is an enlarged view of principal parts of an electronic component lead inspection device according to the fourth embodiment of the present invention. In comparison with the first, second and third embodiments of the present invention, there is no difference in the fourth embodiment of the present invention but rather identical to the first, second and third embodiments, except that a tray 700 moving by being coupled to separate transfer means instead of a pickup header moves the electronic component package still accommodated on the tray 700, and the acquiring means 200 is mounted on a

travelling passage of the electronic component passage and only a light source 710 is used for illuminating a light to the electronic component package moved by the tray 700.

At this time, if the electronic component package is a BGA type  
5 electronic component package, it is being inspected in a flipped-over state, and if a gull wing type electronic component package, it is inspected with a lead portion thereof facing downwards.

Meanwhile, the acquiring means 200 includes, as illustrated in Figure 4,  
image transfer means 210 and first, second and third cameras 250, 260 and 270,  
10 where the image transfer means 210 serves to transfer a bottom view image of the electronic component package 100 to the first camera 250 to allow the bottom view image of the electronic component package 100 to be acquired by the first camera 250, and to transfer images of a first side view and a third side  
view of the electronic component package 100 to the second camera 260 to  
15 allow the images to be acquired by the second camera 260, and to transfer images of a second side view and a fourth side view of the electronic component package 100 to the third camera 270 to allow the images to be acquired by the third camera 270.

Furthermore, the acquiring means 200 is provided with first, second and  
20 third height adjusting means 255, 265 and 275 for adjusting respective heights of the cameras 250, 260 and 270, where, the first, second and third height adjusting means 255, 265 and 275 include guide rails 256, 266 and 276 formed at one side of a housing 280, guide plates 257, 267 and 277 formed integrally with the first, second and third cameras 250, 260 and 270 for vertically moving  
25 the first, second and third cameras 250, 260 and 270 along the guide rails 256, 266 and 276, and fixing means 278 for fixing the guide plates 257, 267 and 277 to the guide rails 256, 266 and 276 to thereby fix positions of the first, second and third cameras 250, 260 and 270.

Although Figure 4 illustrates only the fixing means 278 of the third height adjusting means 276, each fixing means of the first and second height adjusting means 255 and 265 has the same structure as the fixing means 278 of the third height adjusting means 275. The fixing means 278 is provided with a hole (not shown) formed at the guide plate 277, and the hole is formed at an inner periphery thereof with a female screw (not shown) through which a male screw (not shown) passes for screw engagement, and by which the guide plate 277 can be fixed to the guide rail 276.

At this time, it should be apparent that the same effect can be accomplished by utilizing a reflecting mirror and a prism to adjust a height of a transfer passage of an image instead of using the height adjusting means 255, 265 and 275 to adjust the heights of the cameras.

Furthermore, the image transfer means 210 is arranged, as illustrated in Figures 9, 10 and 11, with first image transfer means 221 and 222 for transmitting to the first camera 250 a bottom view image of the electronic component package 100 which is horizontally moved by the pickup header 105 or the tray 700, second image transfer means 231 ~ 237 for combining images of first side view and third side view of the electronic component package 100 to transfer same to the second camera 260 and third image transfer means 241~245 for combining images of second and fourth side views of the electronic component package 100 to transfer same to the third camera 270.

Furthermore, the first image transfer means 221 and 222 include, as illustrated in Figure 9, a first reflecting mirror 221 for reflecting a bottom view image of the electronic component package 100 to a second reflecting mirror 222, and a second reflecting mirror 222 for reflecting the image reflected from the first reflecting mirror 221 to the first camera 250.

The second image transfer means 231 ~ 237 are installed with, as illustrated in Figure 10, third and fourth reflecting mirrors 231 and 232 for

respectively reflecting images from first side view and third side view of the electronic component package 100 to first and second right angle prisms 233 and 234, first and second right angle prisms 233 and 234 for reflecting to a third right angle prism 235 the images of the first and third side views respectively  
5 reflected from the third and fourth reflecting mirrors 231 and 232, a third right angle prism 235 for combining the images respectively reflected from the first and second right angle prisms 233 and 234, the fifth reflecting mirror 236 for reflecting the images combined by the third right angle prism 235 to a sixth reflecting mirror 237, and the sixth reflecting mirror 237 for reflecting the images  
10 reflected by the fifth reflecting mirror 236 back to the second camera 260.

Furthermore, third image transfer means 241 ~ 245 include, as illustrated in Figure 11, seventh and eighth reflecting mirrors 241 and 242 for respectively reflecting images of second side view and fourth side view of the electronic component package 100 to fourth and fifth right angle prisms 243 and  
15 244, the fourth and fifth right angle prisms 243 and 244 for reflecting the images of the second side view and fourth side view reflected from the seventh and eighth reflecting mirrors 241 and 242 back to sixth right angle prism 245, and the sixth right angle prism 245 for combining the images reflected from the fourth and fifth right angle prisms 243 and 244 to reflect same to the third  
20 camera 270.

At this time, the first ~ sixth right angle prisms (233, 234, 235, 243, 244 and 245) are all coated at reflecting surfaces thereof with full reflecting coating material (such as aluminum coating), such that the same effect accomplished by using the right angle prisms can be obtained if reflecting mirrors are used  
25 instead of the first ~ sixth right angle prisms (233, 234, 235, 243, 244 and 245).

Meanwhile, image transfer means 210 according to a second embodiment of the present invention is disposed with, as illustrated in Figures 12a, 12b and 12c, first image transfer means 621 and 622 for transmitting to



the second camera 260 a bottom view image of the electronic component package 100 horizontally moved by the pickup header 105 or the tray 700, second image transfer means (631, 632, 633, 634 and 635) for combining images of first side view and third side view of the electronic component package 100 to transmit same to the third camera 270, and third image transfer means (641 ~ 648) for combining images of second side view and fourth side view of the electronic component package 100 to transfer same to the first camera 250.

Furthermore, the first image transfer means 621 and 622 include, as illustrated in Figure 12a, a first reflecting mirror 621 for reflecting a bottom view image of the electronic component package 100 to the second reflecting mirror 622 and a second reflecting mirror 622 for reflecting the image reflected from the first reflecting mirror 621 to the second camera 260.

The second image transfer means (631 ~ 635) include, as illustrated in Figure 12b, third and fourth reflecting mirrors 631 and 632 for respectively reflecting images of first side view and third side view at the electronic component package 100 to the first and second right angle prisms 633 and 634, first and second right angle prisms 633 and 634 for reflecting the images of first side view and third side view respectively reflected from the third and fourth reflecting mirrors 631 and 632 to the third right angle prism 635, and third right angle prism 635 for combining the images respectively reflected from the first and second right angle prisms 633 and 634 to reflect same to the third camera 270.

Furthermore, the third image transfer means (641 ~ 648) include, as illustrated in Figure 12c, fifth and sixth reflecting mirrors 641 and 642 for respectively reflecting images of second and fourth side views at the electronic component package 100 to seventh and eighth reflecting mirrors 643 and 644, seventh and eighth reflecting mirrors 643 and 644 for reflecting the images of the second and fourth side views reflected from the fifth and sixth reflecting

mirrors 641 and 642 again to fourth and fifth right angle prisms 645 and 646, fourth and fifth right angle prisms 645 and 646 for reflection images of the second and fourth side views reflected from the seventh and eighth reflecting mirrors 643 and 644 to the sixth right angle prism 647, a sixth right angle prism  
5 647 for combining images reflected from the fourth and fifth right angle prisms 645 and 646 to reflect same to the seventh right angle prism 648, and a seventh right angle prism 648 for reflecting the image reflected from the sixth right angle prism 647 to the first camera 250.

Meanwhile, image transfer means 210 according to a third embodiment  
10 of the present invention is the same as illustrated in Figure 13, except that trapezoid prisms 721 and 722 are used when compared with the image transfer means 210 shown in Figures 9, 10, 11 and 12.

In other words, the trapezoid prisms 721 and 722 are used for combination of images instead of the first, second and third right angle prisms  
15 233, 234 and 235 shown in Figures 9 and 10, the fourth, fifth and sixth right angle prisms 243, 244 and 245 illustrated in Figure 11, the first, second and third right angle prisms 633, 634 and 635 given in Figure 12b and the fourth, fifth and sixth right angle prisms 645, 646 and 647 illustrated in Figure 12c.

Now, operational effect of the electronic component lead inspection  
20 device thus constructed according to the embodiment of the present invention will be described.

In the electronic component lead inspection device according to the first, second and third embodiments of the present invention, when an electronic component lead inspection is started, the pickup header 105 picks up the  
25 electronic component package 100 to horizontally move same, and the position detecting means 300 detects a position of the electronic component package 100 horizontally moved by the pickup header 105 to output same to the control means 400.

The control means 400 controls the first light source 115 or the second light source 120 to illuminate light when a signal is input from the position detecting means 300 that the electronic component package 100 has arrived at a acquiring position.

5 In other words, the control means 400 controls the first light source 115 to illuminate the light when the electronic component package 100 horizontally moved by the pickup header 105 is the gull wing type electronic component package, and controls the second light source 120 to illuminate the light when the electronic component package 100 horizontally moved by the pickup header  
10 105 is BGA type electronic component package.

Successively, when the gull wing type electronic component package reaches the acquiring position, the first light source 115 illuminates the light to the reflecting plate 110, such that portion of the electronic component package 100 becomes dark while other background gets brightened.

15 Furthermore, when the BGA type electronic component package arrives at the acquiring position, the second light source 120 illuminates the light to the electronic component package 100 to brighten a portion of the electronic component package lead.

Meanwhile, in the electronic component lead inspection device according  
20 to the fourth embodiment of the present invention, when an electronic component lead inspection is started, the tray 700 accommodated with the electronic component package 100 is horizontally moved and the position detecting means 300 detects a position of the electronic component package 100 horizontally moved by the tray 700 to output same to the control means 400.  
25 When a signal is input from the position detecting means 300 that the electronic component package 100 has reached the acquiring position, the control means 400 controls the light source 710 to illuminate the light.

At this time, in the electronic component lead inspection device according to the first, second, third and fourth embodiments of the present invention, the acquiring means 200 disposed above or underneath the passage of the moving electronic component package 100 outputs to the control signal an image signal that has acquired bottom view and side views of the electronic component package 100, and the control means 400 outputs the image signal input from the acquiring means 200 to the inspecting and displaying means 500, while the inspection and displaying means 500 receives the image signal from the control means 400 to inspect and display the images of bottom view and side views of the electronic component package 100 horizontally moved by the pickup header 105 or the tray 700.

Meanwhile, the acquiring means 200 is equipped with first, second and third cameras 250, 260 and 270 for acquiring bottom view and side views of the electronic component package 100 transmitted by the image transfer means 210, where, only a height adjustment of the third camera 270 will be described by way of example, because height adjustments of the first, second and third cameras 250, 260 and 270 are all the same.

In order to adjust the height of the third camera 270, first of all, fixing means 278 is manipulated to allow the third camera 270 to move upwardly and downwardly. Then, the guide plate 277 integrally formed with the third camera 270 is made to slide upwardly and downwardly along the guide rail 276 to adjust the height of the third camera 270, and again, the fixing means 278 is manipulated to fix the third camera 270.

Hereinafter, a process, where the image transfer means 210 transfer the images of the electronic component package 100 in bottom view and side views to the first, second and third cameras 250, 260 and 270, will be described in detail with reference to Figures 9, 10 and 11.

As illustrated in Figure 9, a bottom view image of the electronic

component package 100 horizontally moved by the pickup header 105 or the tray 700 is reflected by the first reflecting mirror 221 to thereafter be transmitted to and reflected from the second reflecting mirror 222, and to be transmitted to the first camera 250, such that the first camera 250 can acquire the bottom view  
5 image of the electronic component package 100.

Furthermore, as illustrated in Figure 10, the images of first and third side views of the electronic component package 100 horizontally moved by the pickup header 105 or the tray 700 are reflected by the third and fourth reflecting mirrors 231 and 232 to be transmitted to the first and second right angle prisms 233 and 234, and the images of first and third side views of the electronic component package 100 respectively reflected from the third and fourth reflecting mirrors 231 and 232 are reflected from the first and second right angle prisms 233 and 234 to thereafter be transmitted to the third right angle prism 235.  
10

The images of first and third side views of the electronic component package 100 reflected from the first and second right angle prisms 233 and 234 are combined by the third right angle prism 235 to thereafter be transmitted to the fifth reflecting mirror 236, where the images combined by the third right angle prism 235 are reflected by the fifth reflecting mirror 236 to thereafter be  
15 transferred to the sixth reflecting mirror 237.  
20

The images reflected by the fifth reflecting mirror 236 is again reflected by the sixth reflecting mirror 237 to be transmitted to the second camera 260 which, in turn, acquires the images of the first and third side views of the electronic component package 100.

Furthermore, as illustrated in Figure 11, images of the second and fourth side views of the electronic component package 100 horizontally moved by the pickup header 105 or the tray 700 are reflected from the seventh and eight reflecting mirrors 241 and 242 to be transmitted to the fourth and fifth right  
25

angle prisms 243 and 244, where the images of the second and fourth side views of the electronic component package 100 reflected from the seventh and eighth reflecting mirrors 241 and 242 are again reflected by the fourth and fifth right angle prisms 243 and 244 to thereafter be transmitted to the sixth right angle prism 245.

The images reflected from the fourth and fifth right angle prisms 243 and 244 are combined by the sixth right angle prism 245 to be transferred to the third camera 270, where the third camera 270 acquires the images of the second and fourth side views of the electronic component package 100.

At this time, if the electronic component package 100 horizontally moved by the pickup header 105 is the gull wing type electronic component package, the image acquired by the first camera 250 becomes a bottom view of the electronic component package 100, as illustrated in Figure 14a, the image acquired by the second camera 260 becomes an image combined by the first and third side views of the electronic component package 100, as illustrated in Figure 14b, and the image acquired by the third camera 270 becomes an image combined by the second and fourth side views of the electronic component package 100, as illustrated in Figure 14c.

Furthermore, if the electronic component package 100 horizontally moved by the pickup header 105 is a BGA type electronic component package, the image acquired by the first camera 250 becomes a bottom view of the electronic component package 100, as illustrated in Figure 15a, the image acquired by the second camera 260 becomes an image combined by images from the first and third side views of the electronic component package 100 as illustrated in Figure 15b, and the image acquired by the third camera 270 is an image combined by images from the second and fourth side views of the electronic component package 100, as illustrated in Figure 15c.

Successively, a process where image transfer means 210 according to the

second embodiment of the present invention transfers the images of bottom and side views of the electronic component package 100 to the first, second and third cameras 250, 260 and 270 will be described in detail with reference to Figures 12a, 12b and 12c.

5       As illustrated in Figure 12a, a bottom view of the electronic component package 100 horizontally moved by the pickup header 105 or the tray 700 is sequentially reflected by the first and second reflecting mirrors 621 and 622 to be transmitted to the second camera 260, such that the second camera 260 becomes to acquire the bottom view of the electronic component package 100.

10       Furthermore, as illustrated in Figure 12b, images of first and third side views of the electronic component package 100 horizontally moved by the pickup header 105 or the tray 700 are reflected by the third and fourth reflecting mirrors 631 and 632 and by the first and second right angle prisms 633 and 634 to thereafter be transmitted to the third right angle prism 635, and the third camera  
15       270 becomes to acquire the images of the first and third side views of the electronic component package 100 as images of the first and third side views of the electronic component package 100 are combined by the third right angle prism 635 to thereafter be transferred to the third camera 270.

Successively, as illustrated in Figure 12c, images of second and fourth  
20       side views of the electronic component package 100 horizontally moved by the pickup header 105 or the tray 700 are respectively reflected by the fifth and sixth reflecting mirrors 641 and 642, the seventh and eighth reflecting mirrors 643 and 644, and the fourth and fifth right angle prisms 645 and 646 to thereafter be transmitted to the sixth right angle prism 647, where the sixth right angle prism  
25       647 combines the images reflected by the fourth and fifth right angle prisms 645 and 646 to be transferred to the seventh prism 648, and the seventh right angle prism 648 reflects the image transmitted from the sixth right angle prism 647 to transfer same to the first camera 250, such that the first camera 250 can acquire

the images of the second and fourth side views of the electronic component package 100.

At this time, if the electronic component package 100 horizontally moved by the pickup header 105 is a gull wing type electronic component package, the  
5 image acquired by the second camera 260 becomes a bottom view of the electronic component package 100 as illustrated in Figure 14a, the image acquired by the third camera 270 becomes an image combined from the first and third side views of the electronic component package 100 as illustrated in Figure 14b, and the image acquired by the first camera 250 becomes an image  
10 combined from the second and fourth side views of the electronic component package 100 as illustrated in Figure 14c.

Furthermore, if the electronic component package 100 horizontally moved by the pickup header 105 is BGA type electronic component package, an  
15 image acquired by the second camera 260 becomes a bottom view of the electronic component package 100 as illustrated in Figure 15a, an image acquired by the third camera 270 becomes an image combined from the first and third side views of the electronic component package 100 as illustrated in Figure 15b, and an image acquired by the first camera 250 becomes an image combined from the second and fourth side views of the electronic component  
20 package 100 as illustrated in Figure 15c.

As apparent from the foregoing, there is an advantage in the present invention thus described in that an electronic component package being picked up, moved, inspected and produced can be all inspected on real time and there is no damage caused to an electronic component lead either.

25 Furthermore, there is another advantage in that a three-dimensional lead inspect using stereo vision method is possible on the ball grid array type electronic component package and the gull wing type electronic component package by way of one inspection device. There is still another advantage in that



inspects on the coplanarity, warpage, mold damage and the like can be performed and the present invention can be used in easy coupling to an existing electronic component device.

FIG. 1 is a perspective view of a mold assembly according to the present invention.

## WHAT IS CLAIMED IS:

1. An electronic component lead inspection device, the device comprising:

a pickup header for picking up an electronic component package to move same;

5 a light source for illuminating a light to the electronic component package;

acquiring means for acquiring an image of the electronic component package underneath a travelling passage of the electronic component package;

control means for outputting an image signal of the electronic component package acquired by the acquiring means; and

10 inspecting and displaying means for receiving the image signal of the electronic component package output from the control means to inspect and display the image of the electronic component package.

2. An electronic component lead inspection device, the device comprising:

15 a pickup header for picking up an electronic component package to move same;

a reflecting plate attached to the pickup header;

a light source for illuminating a light to the reflecting plate;

20 acquiring means for acquiring an image of the electronic component package underneath a travelling passage of the electronic component package;

control means for outputting an image signal of the electronic component package acquired by the acquiring means; and

25 inspecting and displaying means for receiving the image signal of the electronic component package output from the control means to inspect and display the image of the electronic component package.

3. An electronic component lead inspection device, the device comprising:

a pickup header for picking up an electronic component package to move same;

a reflecting plate attached to the pickup header;  
 a first light source for illuminating a light to the reflecting plate;  
 a second light source for illuminating a light to the electronic component package;

5        acquiring means for acquiring an image of the electronic component package underneath a travelling passage of the electronic component package;

control means for controlling the first light source to illuminate a light if the electronic component package is a gull wing type electronic component package and for controlling the second light source to illuminate a light if the  
 10        electronic component package is a ball grid array type electronic component package and for outputting an image signal of the electronic component package acquired by the acquiring means; and

inspecting and displaying means for receiving the image signal of the electronic component package output from the control means to inspect and  
 15        display the image of the electronic component package.

4. An electronic component lead inspection device, the device comprising:

a tray for moving an accommodated electronic component;  
 a light source for illuminating a light to the electronic component package;

20        acquiring means for acquiring an image of the electronic component package above a travelling passage of the electronic component package;

control means for outputting an image signal of the electronic component package acquired by the acquiring means; and

inspecting and displaying means for receiving the image signal of the  
 25        electronic component package output from the control means to thereby inspect and display the image of the electronic component package.

5. The electronic component lead inspection device as defined in any one of claims 1 to 4, wherein the acquiring means comprises:

image transfer means for transmitting images of bottom view and side

views of the electronic component package; and

more than one camera for acquiring the images of bottom and side views of the electronic component package transferred through the image transfer means.

- 5 6. The electronic component lead inspection device as defined in claim 5, wherein the image transfer means comprises:

a first image transfer means for transmitting a bottom view of the electronic component package to a camera;

- 10 second and third image transfer means for combining images of mutually facing side views of the electronic component package to thereafter transfer same to a camera.

- 15 7. The electronic component lead inspection device as defined in claim 6, wherein the first image transfer means comprises at least more than one reflecting mirror for reflecting the bottom view of the electronic component package to thereafter transfer same to a camera.

8. The electronic component lead inspection device as defined in claim 6, wherein the second and third image transfer means comprise:

- 20 more than two reflecting mirrors for respectively reflecting images of mutually facing side views of the electronic component package; and more than one right angle prism for combining images respectively reflected by the reflecting mirror to the one camera.

9. The electronic component lead inspection device as defined in claim 6, wherein the camera comprises:

- 25 a first camera for acquiring a bottom view of the electronic component package transmitted from the first image transfer means; and

second and third cameras for acquiring respective images of side views of the electronic component package combined and transmitted thereafter by the second and third image transfer means.

10. The electronic component lead inspection device as defined in claim 5, wherein the image transfer means further comprises a height adjusting means for adjusting heights of the camera.

11. The electronic component lead inspection device as defined in claim 10,  
5 wherein the height adjusting means comprises:

a guide rail formed at one side of a housing;

a guide plate integrally formed at the camera to upwardly and downwardly move the camera along the guide rail; and

fixing means for fixing the guide plate to the guide rail to thereby fix a  
10 position of the camera.

12. The electronic component lead inspection device as defined in any one of claim 1 to 4, wherein the acquiring means comprising:

image transfer means disposed on an upper portion of a housing to transfer image of bottom and side views of the electronic component package;

15 and

first, second and third cameras provided underneath the housing to respectively acquire bottom and side views of the electronic component package transmitted via the image transfer means, while the image transfer means comprises:

20 a pair of reflecting mirrors centrally arranged at a housing for twice reflecting at right angle a bottom view of the electronic component package to thereafter transfer same to the first camera;

four reflecting mirrors respectively disposed at four side views of the housing to reflect four side views of the electronic component package lengthwise  
25 of the housing;

four right angle prisms mounted at four side views of the housing to respectively face the four reflecting mirrors to reflect at right angle the images of four side views reflected from the four reflecting mirrors relative to lengthwise direction of the housing; and

two right angle prisms respectively disposed between two facing right angle prisms out of the four right angle prisms to combine images of two side views of the two facing electronic component package and to respectively transfer same to the second and third camera.

- 5 13. The electronic component lead inspection device as defined in any one of claims 1 to 4, wherein the acquiring means comprises:

image transfer means for transmitting a bottom view of the electronic component package; and

- 10 more than one camera for acquiring the bottom view of the electronic component package transmitted via the image transfer means.

14. The electronic component lead inspection device as defined in any one of claims 1 to 4, wherein the acquiring means comprising:

image transfer means for combining and transmitting images of mutually-facing side views of the electronic component package; and

- 15 more than one camera for acquiring images of side views of the electronic component package transmitted from the image transfer means.

15. The electronic component lead inspection device as defined in any one of claims 1 to 4, wherein the acquiring means further comprises a glass plate for permeating images of the electronic component package but for preventing  
20 foreign objects such as dust, mold flesh and the like from entering the acquiring means.

16. An electronic component lead inspection device adapted to transmit an image of an electronic component package by way of image transfer means and to acquire the image transmitted by the image transfer means by way of a  
25 camera, wherein the image transfer means comprises:

more than two reflecting mirrors for respectively reflecting images of mutually facing side views of the electronic component package; and

more than one right angle prism for combining images respectively

reflected by the reflecting mirrors to transfer same to the one camera.

$\frac{1}{13}$ 

FIG. 1

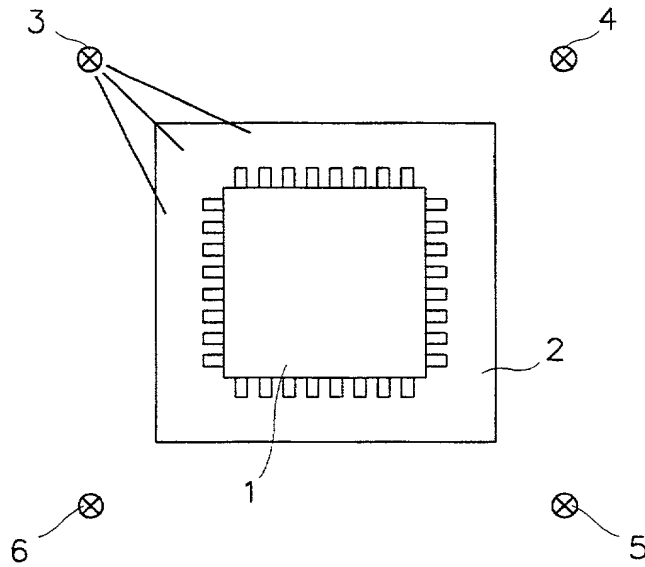
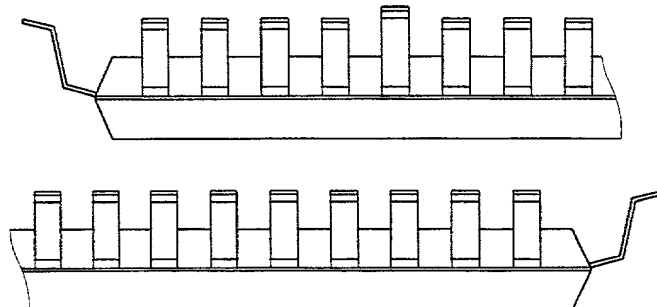


FIG. 2a



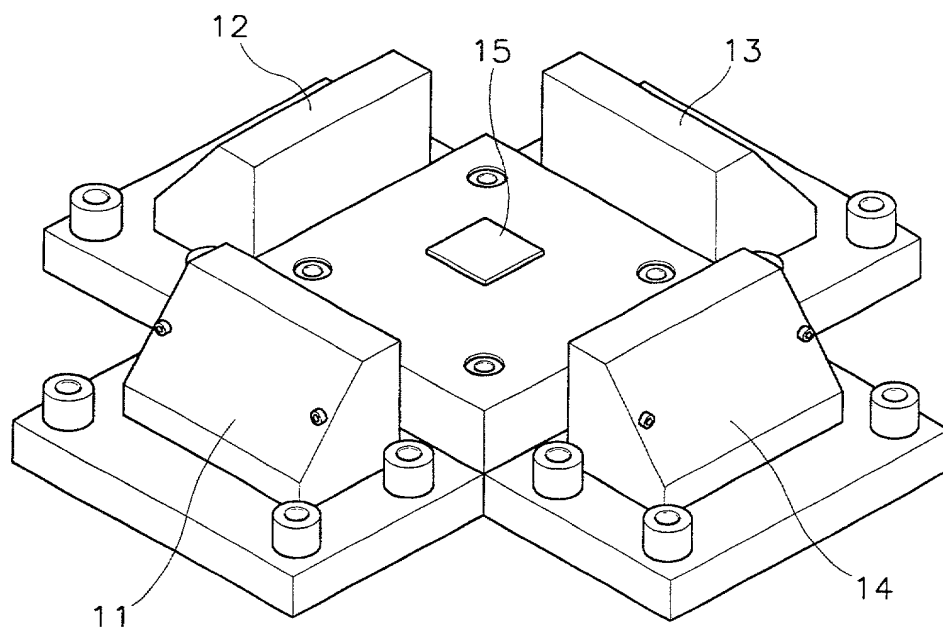
FIG. 2b





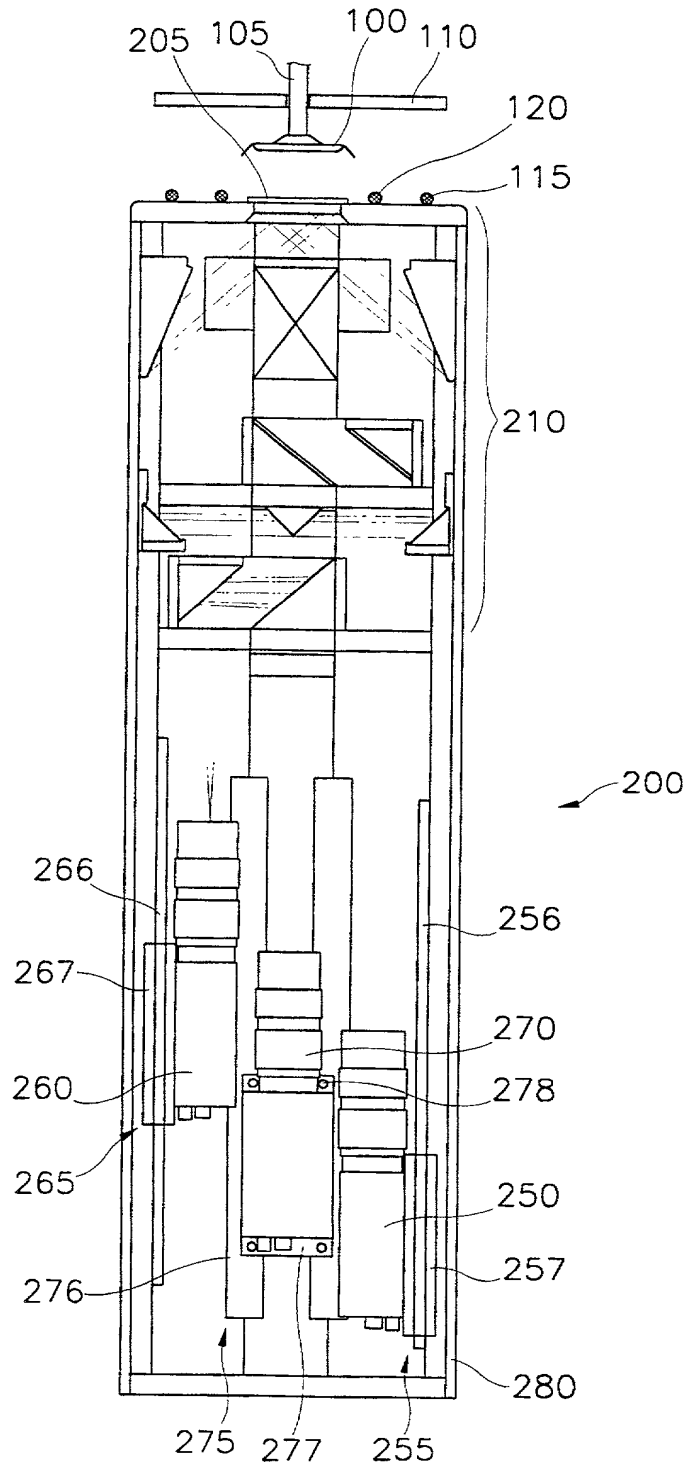
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FIG.3



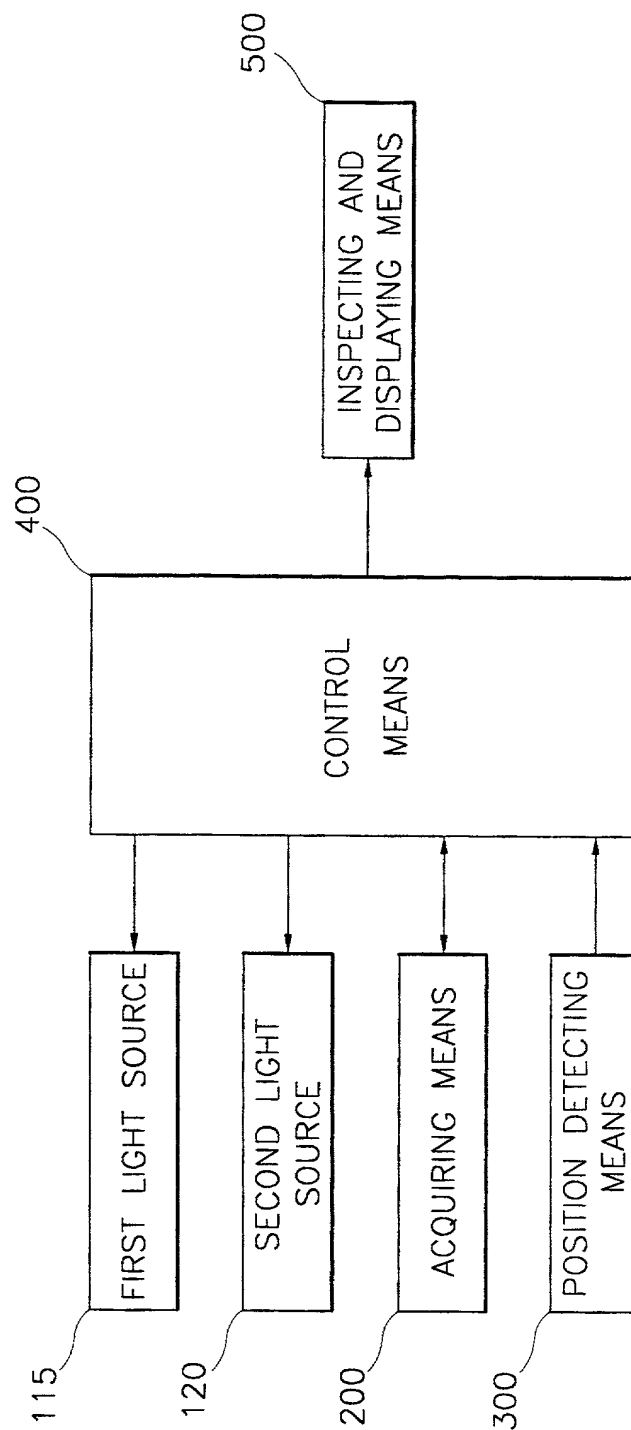
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FIG. 4



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FIG.5



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FIG.6

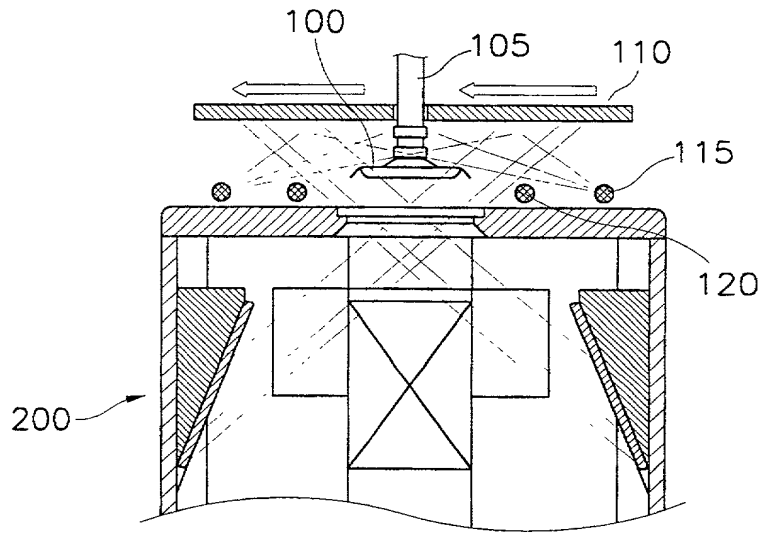
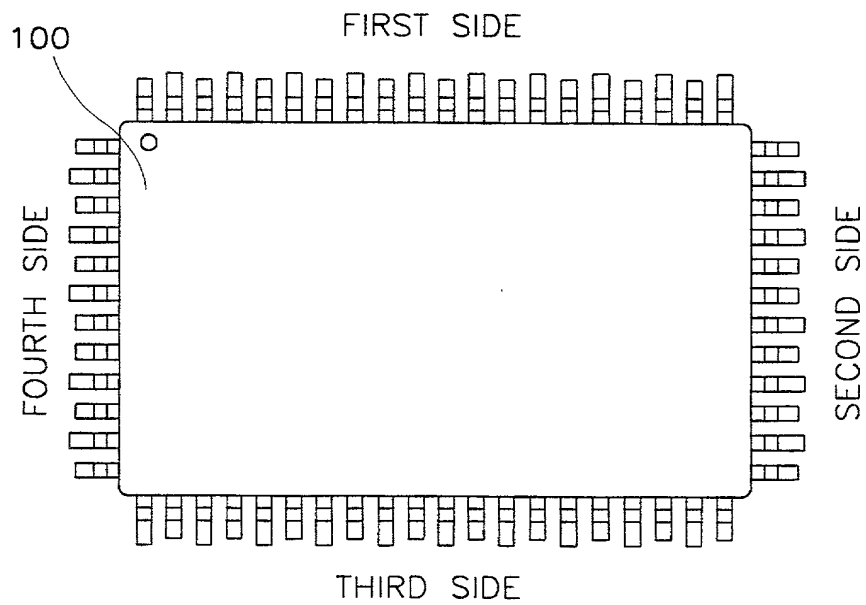


FIG.8

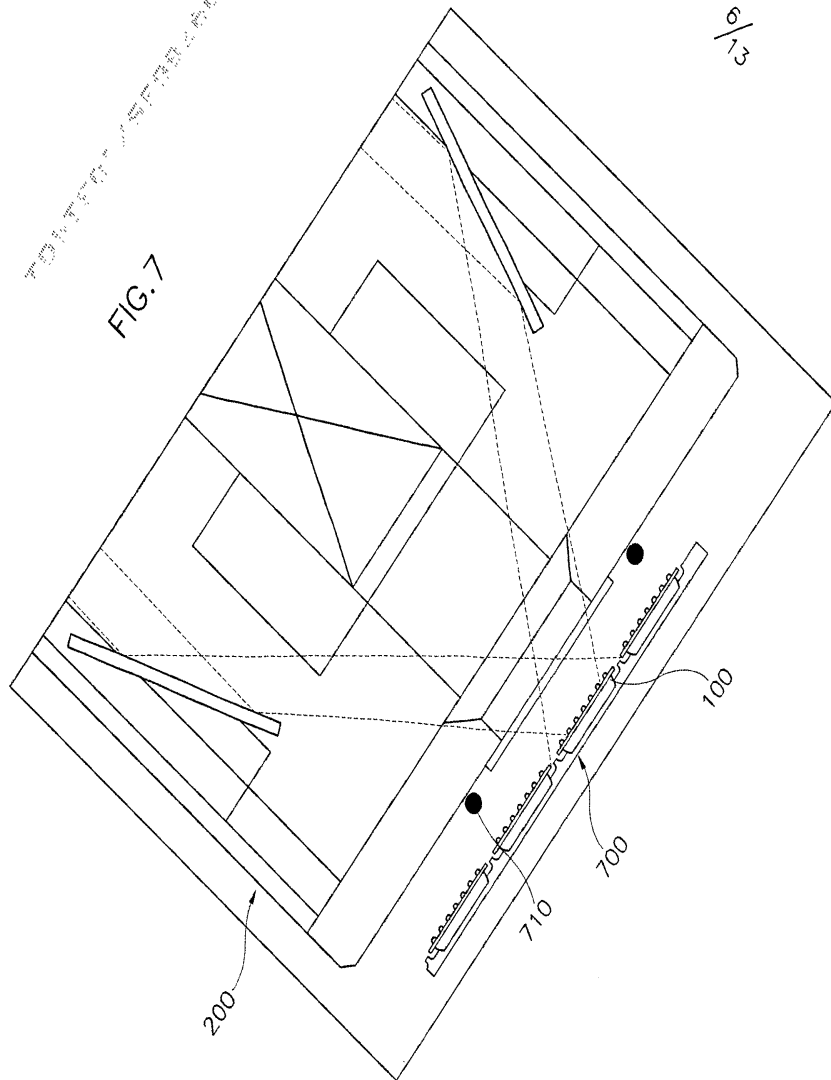


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FIG. 7

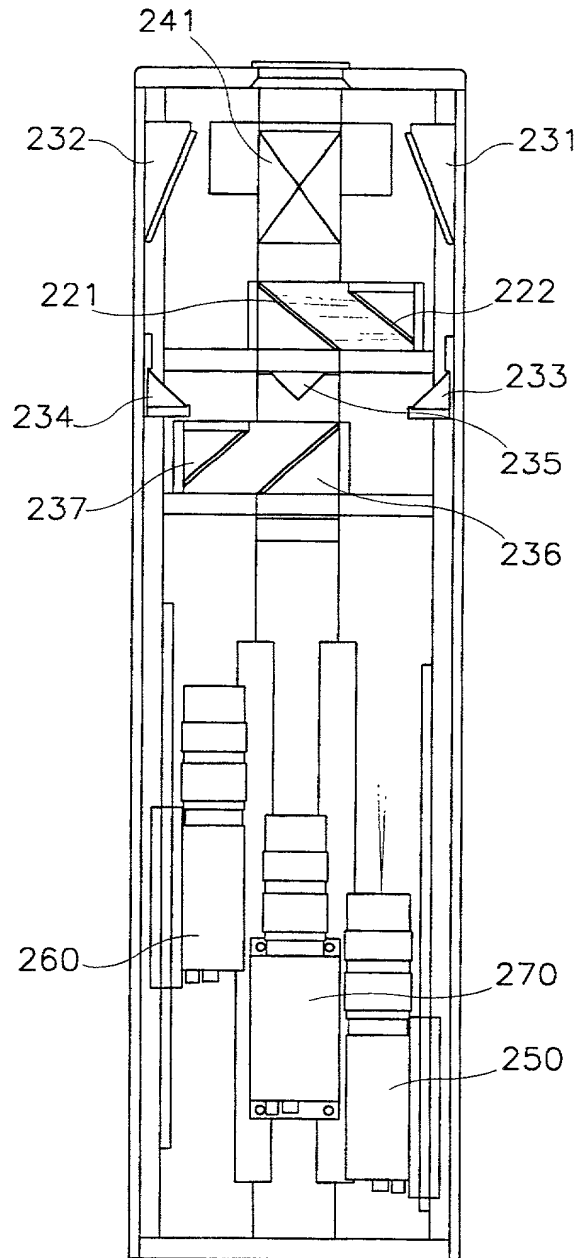
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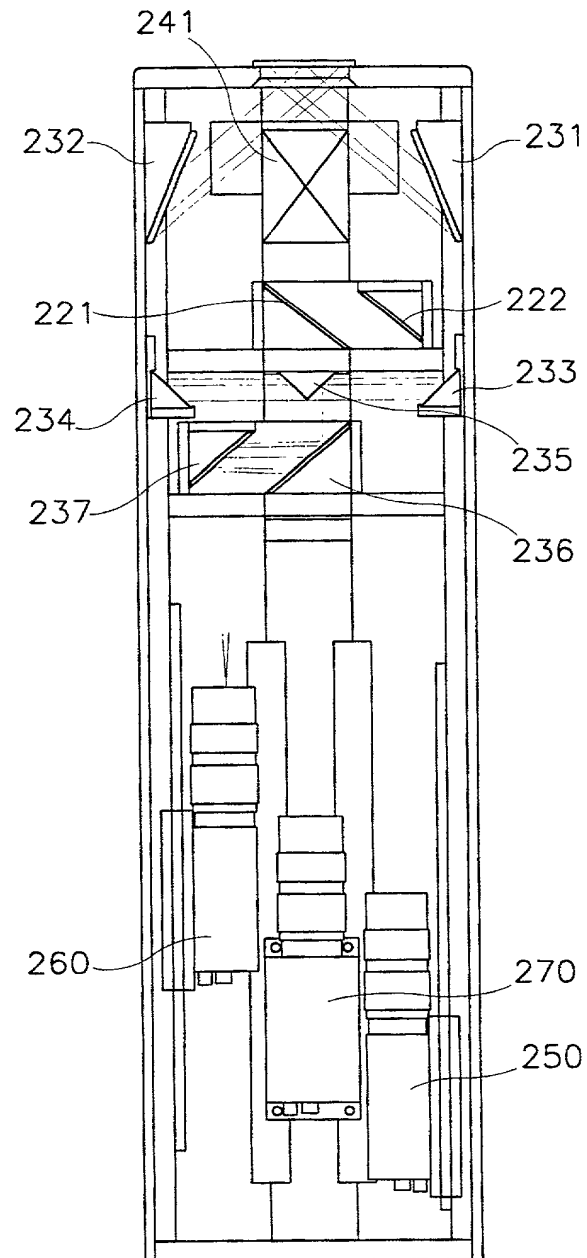
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FIG.9



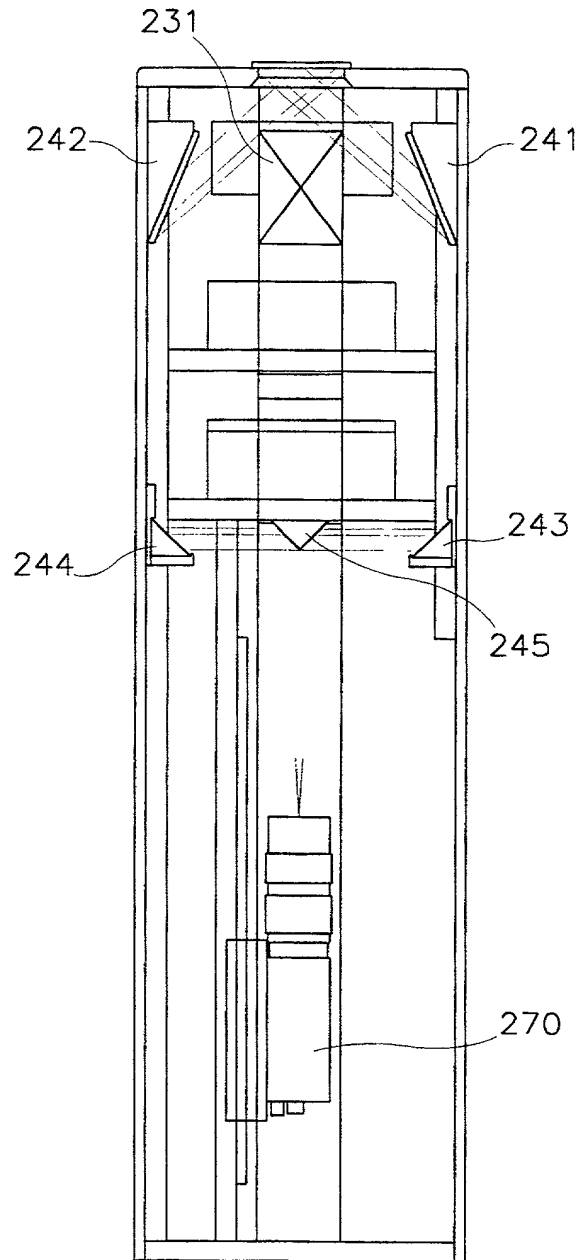
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FIG. 10



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FIG.11





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FIG.12a

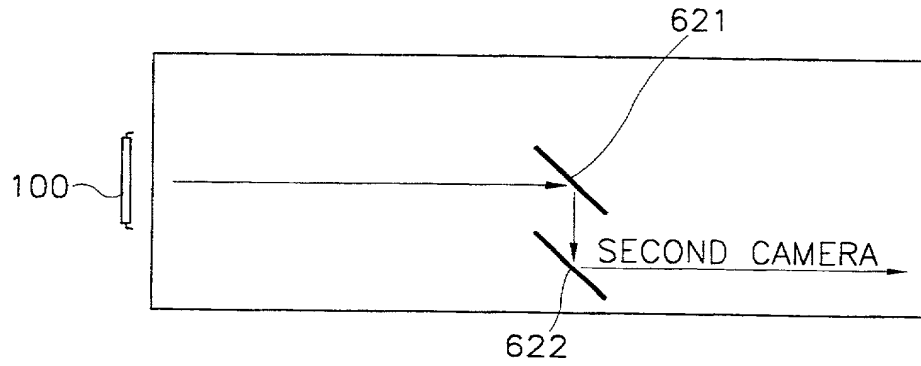
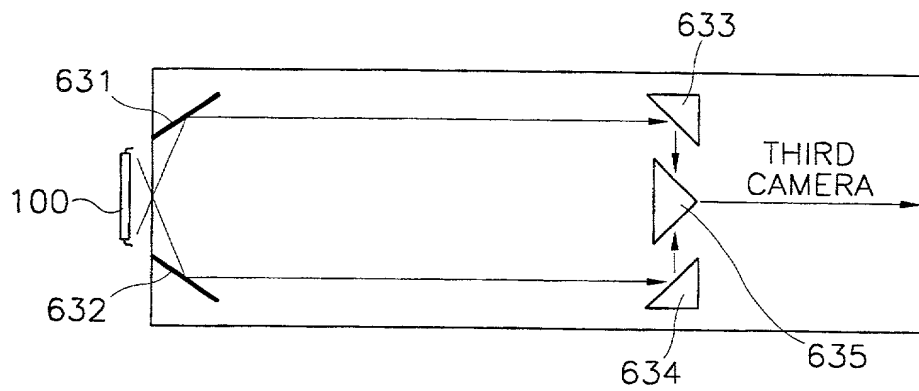


FIG.12b



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FIG.12c

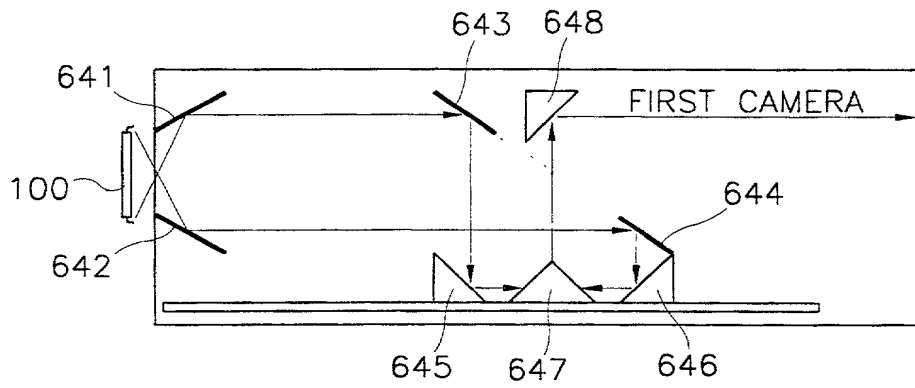
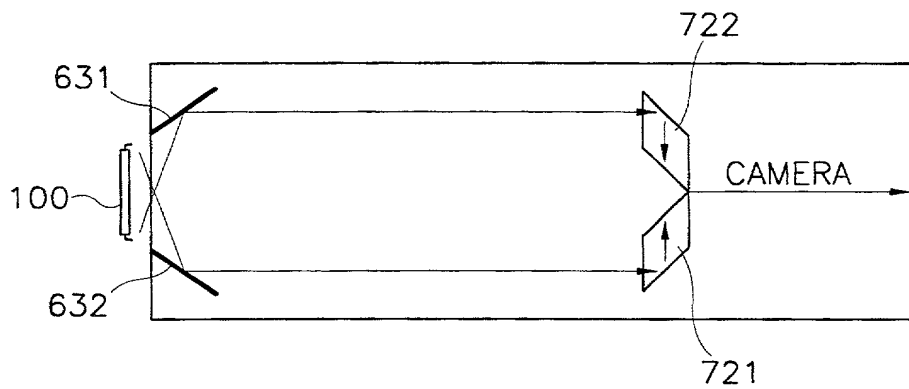


FIG.13



$\frac{12}{13}$ 

FIG. 14a

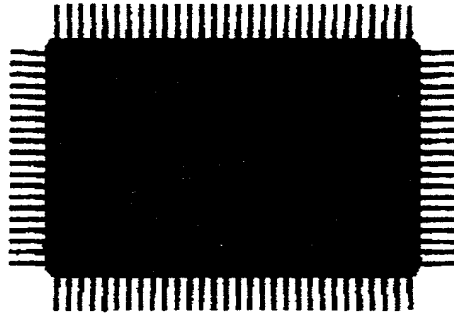


FIG. 14b

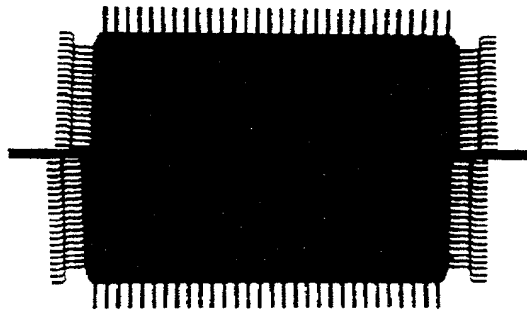
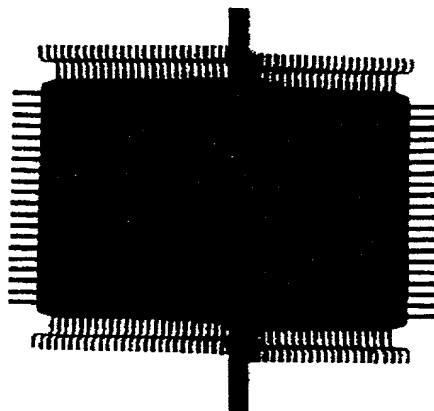


FIG. 14c



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FIG. 15a

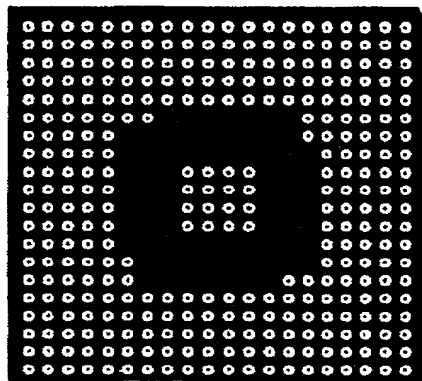


FIG. 15b

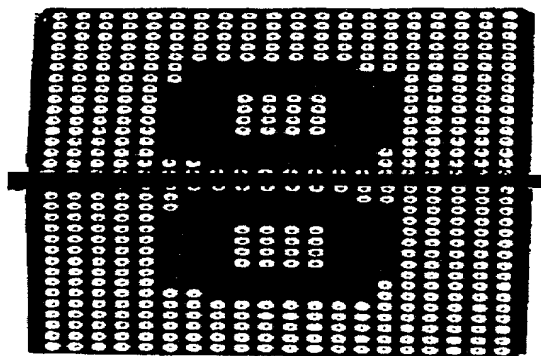
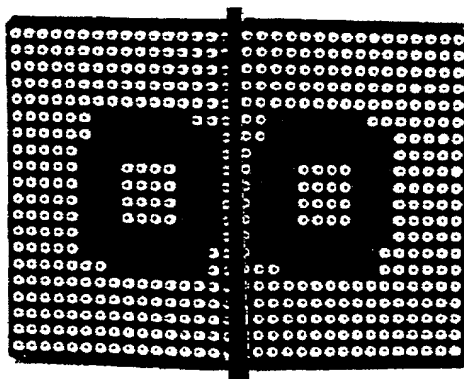


FIG. 15c



# DECLARATION FOR PATENT APPLICATION AND APPOINTMENT OF ATTORNEY

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name; I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention (Design, if applicable) entitled:

## ELECTRONIC COMPONENT LEAD INSPECTION DEVICE

the specification of which (check one):

☒ is attached hereto, or ☐ was filed on:

as U.S. Application Number or PCT International Application Number:

and (if applicable) was amended on:

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment(s) referred to above. I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 56. I hereby claim foreign priority benefits under Title 35, United States Code § 19 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

PRIOR FOREIGN APPLICATION(S)			PRIORITY CLAIMED	
Number	Country	Day/Month/Year Filed	Yes	No
98-38479	Rep. of Korea	17/Sep./1998	X	
99-31796	Rep. of Korea	03/Aug./1999	X	

☐ Additional Priority Application(s) Listed on Following Page(s)

I HEREBY CLAIM THE BENEFIT UNDER TITLE 35 U.S. CODE <input type="checkbox"/> 19(E) OF ANY U.S. PROVISIONAL APPLICATIONS LISTED BELOW.	
Application Number	Day/Month/Year Filed

☐ Additional Provisional Application(s) Listed on Following Page(s)

I hereby claim the benefit under Title 35, United States Code, § 20 of any United States application(s) or PCT international application(s) designating The United States of America listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, § 12, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 56 which became available between the filing date of the prior application(s) and the national or PCT international filing date of this application:

Application Number	Filing Date	Status - Patented, Pending or Abandoned
PCT/KR99/00557	16/Sep./1999	Pending

☐ Additional US/PCT Priority Application(s) listed on Following Page(s)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: I (We) hereby appoint as my (our) attorneys, with full powers of substitution and revocation, to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: J. Ernest Kenney, Reg. No. 19,179; Eugene Mar, Reg. No. 25,893; Richard E. Fichter, Reg. No. 26,382; Thomas J. Moore, Reg. No. 28,974; Joseph DeBenedictis, Reg. No. 28,502; Benjamin E. Urcia, Reg. No. 33,805; and

I(we) authorize my(our) attorneys to accept and follow instructions from \_\_\_\_\_ regarding any matter related to the preparation, examination, grant and maintenance of this application, any continuation, continuation-in-part or divisional based thereon, and any patent resulting therefrom, until I(we) or my(our) assigns withdraw this authorization in writing.

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DATE <u>6 / March / 2001</u>	SIGNATURE <u>Jong-Ju Choi</u>

☒ See following page(s) for additional joint inventors.


## CONTINUATION OF DECLARATION FOR PATENT APPLICATION AND APPOINTMENT OF ATTORNEY

Page 2

PRIOR FOREIGN APPLICATION(s) (35 USC <input type="checkbox"/> 19)			PRIORITY CLAIMED	
Number	Country	Day/Month/Year Filed	Yes	No

PRIOR PROVISIONAL APPLICATIONS 35 U.S. CODE <input type="checkbox"/> 19(E)	
Application Number	Day/Month/Year Filed

PRIOR U.S. OR PCT INTERNATIONAL APPLICATIONS (35 U.S. CODE <input type="checkbox"/> 20)		
Application Number	Filing Date	Status - Patented, Pending or Abandoned

FULL NAME OF JOINT INVENTOR <b>Dong-Sik Jang</b>	CITIZENSHIP <b>Korean</b>
RESIDENCE ADDRESS <b>104-202 Hansin Apt., 609-1, Donam-dong, Seongbuk-gu, Seoul, 136-060, Rep. of Korea</b>	POST OFFICE ADDRESS IS THE SAME AS RESIDENCE ADDRESS UNLESS OTHERWISE SHOWN BELOW
DATE <b>6/March/2001</b>	SIGNATURE 

FULL NAME OF JOINT INVENTOR	CITIZENSHIP
RESIDENCE ADDRESS	POST OFFICE ADDRESS IS THE SAME AS RESIDENCE ADDRESS UNLESS OTHERWISE SHOWN BELOW
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